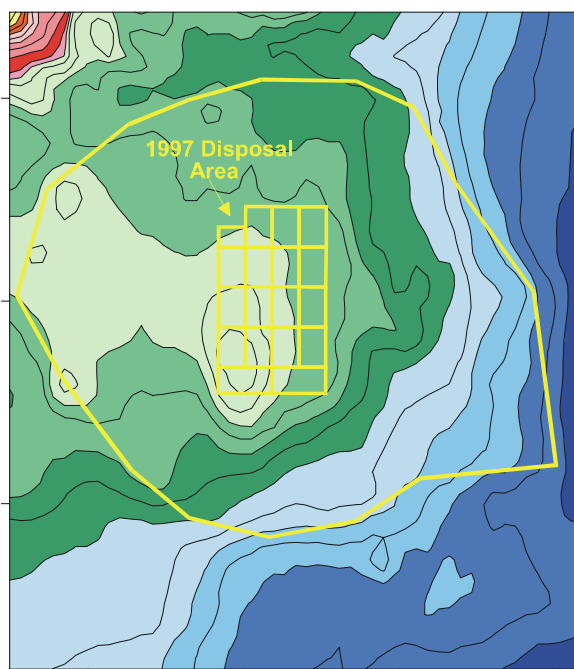

**THE 1997 CATEGORY II CAPPING PROJECT
AT THE NEW YORK MUD DUMP SITE:
RESULTS FROM THE APRIL 1998
POSTCAP BATHYMETRY SURVEY**



Prepared by:

Science Applications
International Corporation
Admiral's Gate
221 Third Street
Newport, RI 02840

Prepared for:

U.S. Army Corps of Engineers
New York District, Operations Division
26 Federal Plaza
New York, NY 10278-0090

August 1998

Delivery Order No. 6 of Indefinite Quantity Contract No. 49

USACE Contract No. DACW51-97-D-0014
SAIC Project No. 01-0440-04-8650-420
Report No. 83 of the New York Mud Dump Site Studies
SAIC Report No. 438

ACKNOWLEDGMENT

This report presents results from the first postcap bathymetry survey for the 1997 Category II Capping Project at the New York Mud Dump Site. This survey was conducted by Science Applications International Corporation (SAIC) of Newport, RI, under Delivery Order 6 of SAIC's Indefinite Delivery Contract No. DACW51-97-D-0014 with the U.S. Army Corps of Engineers - New York District (NYD). Mr. Brian May is the manager of technical activities under the NYD contract; Dr. Scott McDowell is SAIC's program manager; Mr. Ed DeAngelo is the project leader for Delivery Order 6.

Logistical and planning support for the survey was provided by Mr. Brian May of NYD with assistance from Mr. Tim LaFontaine.

Ms. Kate Pickle, Mr. Jason Infantino, and Mr. DeAngelo were responsible for mobilizing the field equipment and conducting the survey operations aboard the Corps vessel M/V *Gelberman*. The crew of the M/V *Gelberman* should be commended for their skill in vessel handling while running the bathymetric survey lines, as well as their dedication during long hours of operations at the Mud Dump Site.

Mr. Infantino processed the bathymetric data and produced the graphic data products whereas Mr. DeAngelo and Mr. Infantino prepared this report. Dr. McDowell provided technical review of the report, while Mr. Tom Fox was responsible for report production.

BACKGROUND

During the 1997 Category II Project, approximately 850,000 yd³ of dredged material (pre-dredge volume) were placed at the New York Mud Dump Site (MDS) located 6 nmi off the coast of Sandy Hook, NJ (Figure 1). During the period from May 27 through August 6, 1997, (Figure 2) the disposal of Category II dredged material was directed to a series of disposal cells located on the flanks of the Experimental Mud Dump (EMD) mound in the southeastern portion of the MDS (Figure 3). Following the disposal activity bathymetric analysis and REMOTS® sediment profile imagery were used to measure the newly formed mound and to identify the areal coverage, or footprint, of Category II dredged material on the seafloor (Figure 4).

Under the dredging/disposal permit, the Port Authority of NY/NJ (PA) was responsible for placing a 1-m thick sand cap over the entire Category II dredged material footprint. The dredged material footprint was divided into a grid of rows and columns spaced 100 ft apart (Figure 5). The rows and columns served as track lines and provided guidance for hopper dredges during sand dispersal operations. Sand dispersal activities were closely monitored by the PA and the U.S. Army Corps of Engineers - New York District (NYD) to ensure that sand was evenly distributed over the entire footprint. Figure 5 shows the location of the hopper dredges during sand cap disposal events. These sand cap disposal tracts were recorded by the SAIC-operated New York Disposal Surveillance System (NYDISS) (SAIC 1997a) units installed aboard the hopper dredges. During the capping period of August 1997 through January 1998, the PA placed nearly 2 million yd³ of sand, dredged from Ambrose Channel, over the entire Category II material footprint.

To assess the topography and thickness of the sand cap, the PA conducted a series of interim-cap precision bathymetric surveys and one subbottom profiling survey within the project area (SAIC 1998a). Based on results from the bathymetric survey conducted on February 1, 1998, the PA concluded that all of the Category II dredged material had been covered with a sand cap at least 1-m thick.

A postcap bathymetric survey was conducted by the NYD in order to verify final capping coverage and the PA results. This report presents results of the postcap bathymetric survey conducted on April 8, 1998. Cap completion was assessed using data from the postdisposal bathymetric survey, conducted in August 1997, as a baseline for depth difference analysis.

BATHYMETRIC SURVEY OPERATIONS

Survey operations were conducted aboard the NYD's M/V *Gelberman* during the period of April 7-8, 1998. The survey area measured 1500 m (north-south) by 1300 m (east-west), identical to that of the interim-disposal surveys. The center of the survey region corresponded with the target location for the disposal mound of the 1997 Category II capping project.

Vessel positioning and data integration were achieved with SAIC's Portable Integrated Navigation Survey System (PINSS). This PC-based system provides real-time navigation, and collection of position, time, and depth soundings for subsequent analysis. Vessel positioning was determined using a Trimble GPS receiver. One to 5-m Differential GPS accuracy was achieved

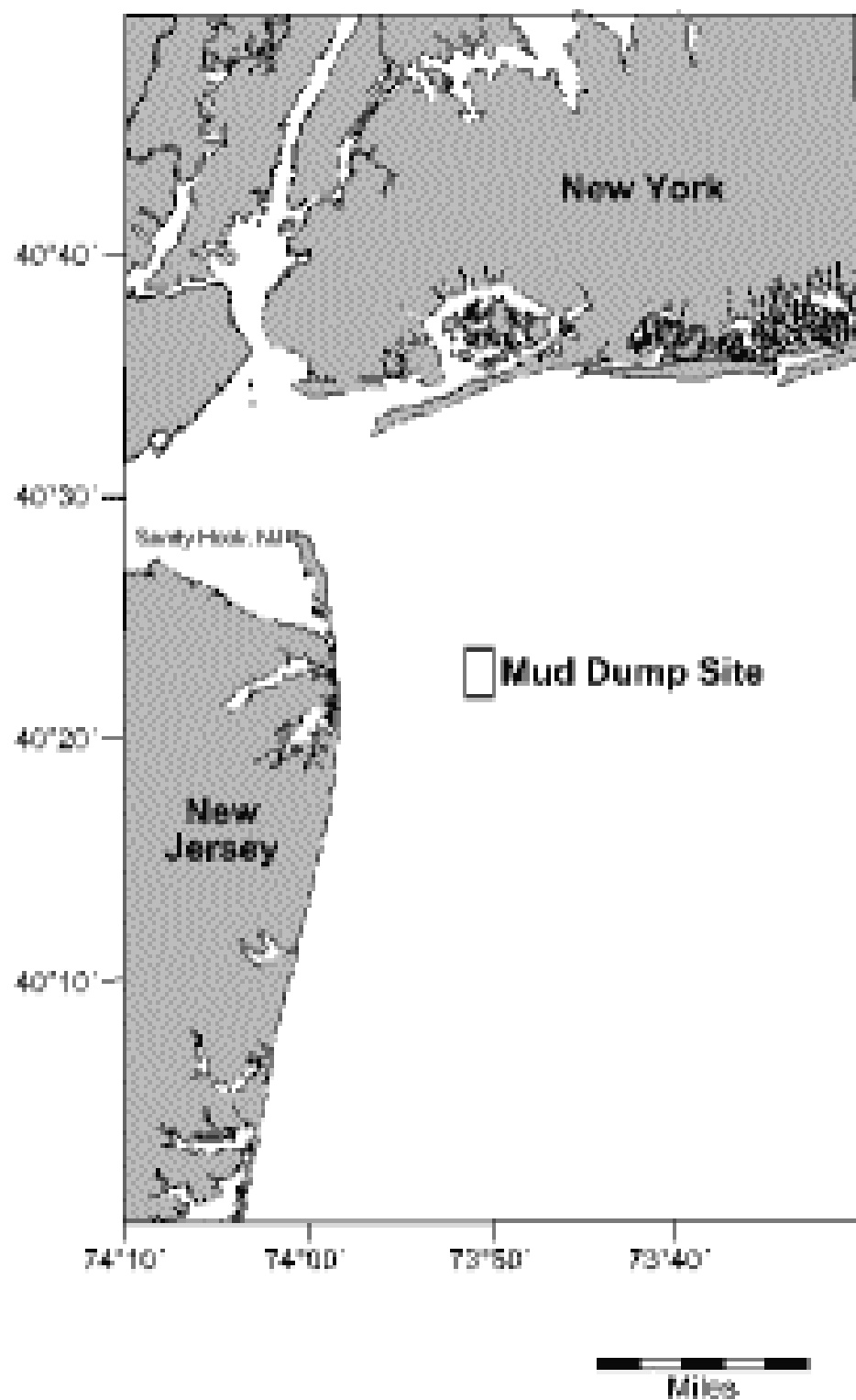


Figure 1. Location of the Mud Dump Site (MDS) in the New York Bight.

1997 Capping Project Time Line



Figure 2. 1997 Category II Project timeline.

**1997 Capping Project
Baseline Bathymetry
April 23, 1997**

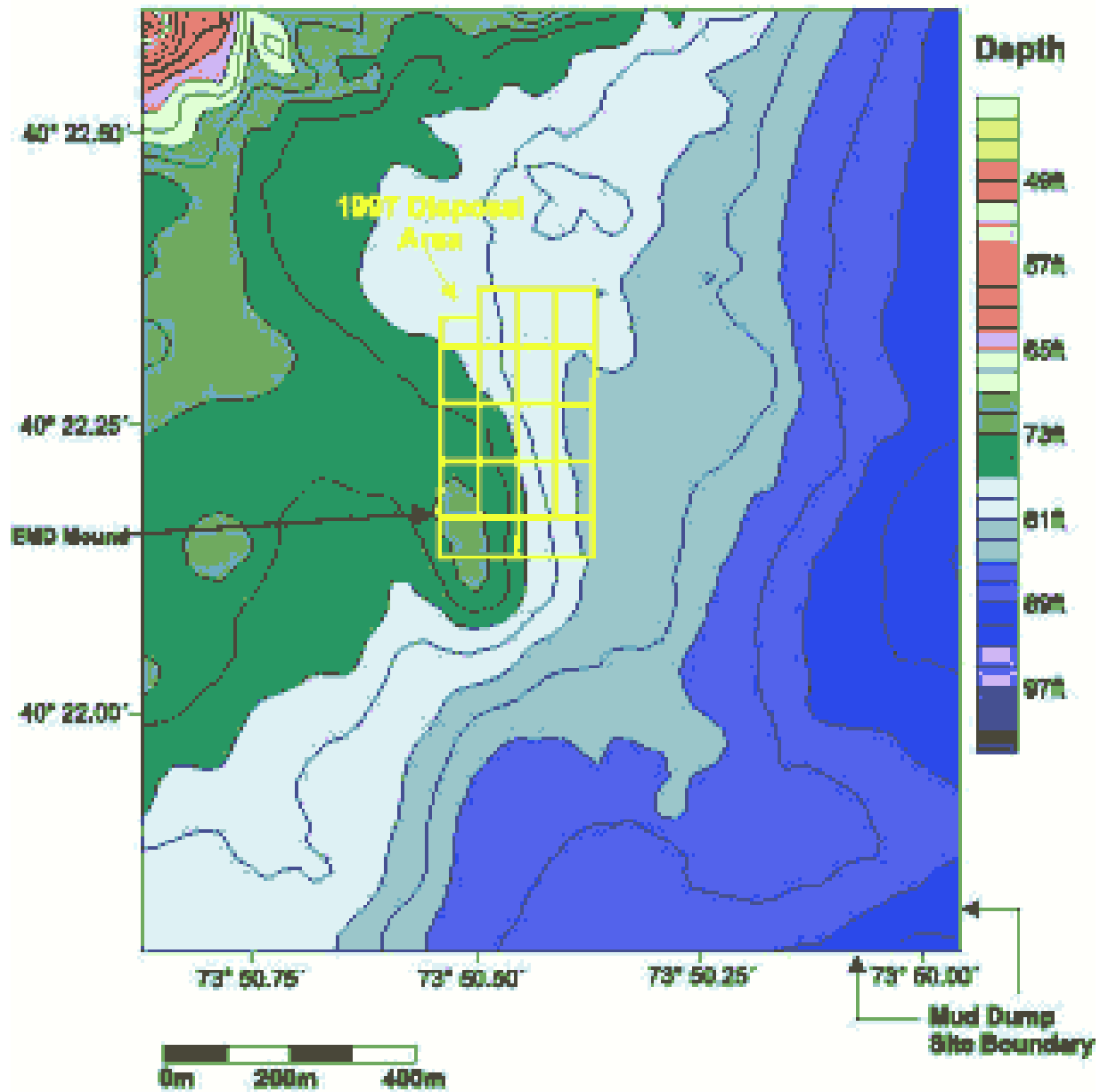


Figure 3. 2-dimensional color contour plot of Baseline bathymetry results.

**1997 Capping Project
Post-Disposal Bathymetry
August 19, 1997**

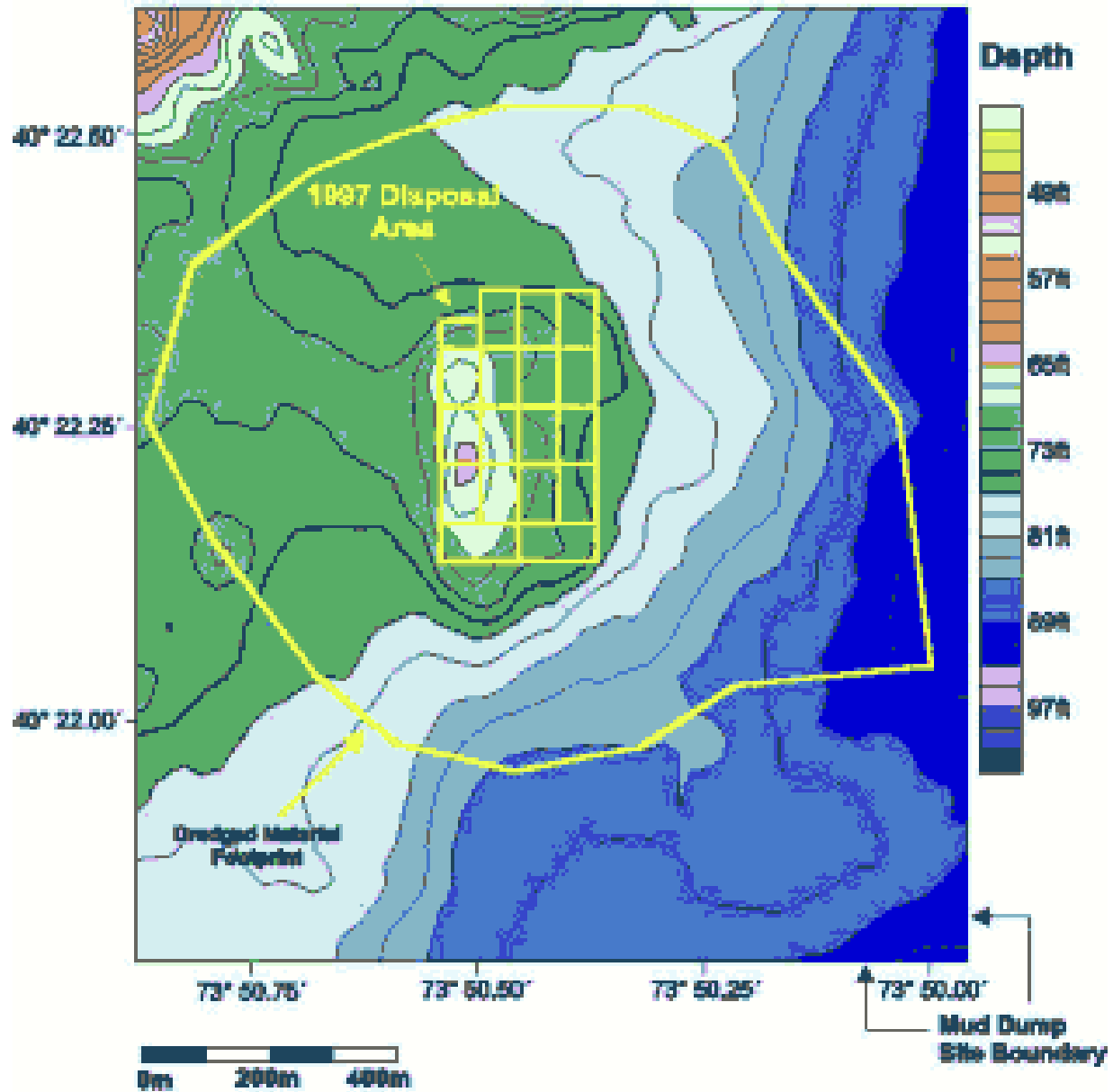


Figure 4. Color contour plot of topographic features from the post-disposal bathymetry of the Category II dredged material mound. The dredged material disposal cells and footprint have been plotted for reference.

1997 Capping Project NYDISS Sand Dispersal Tracks

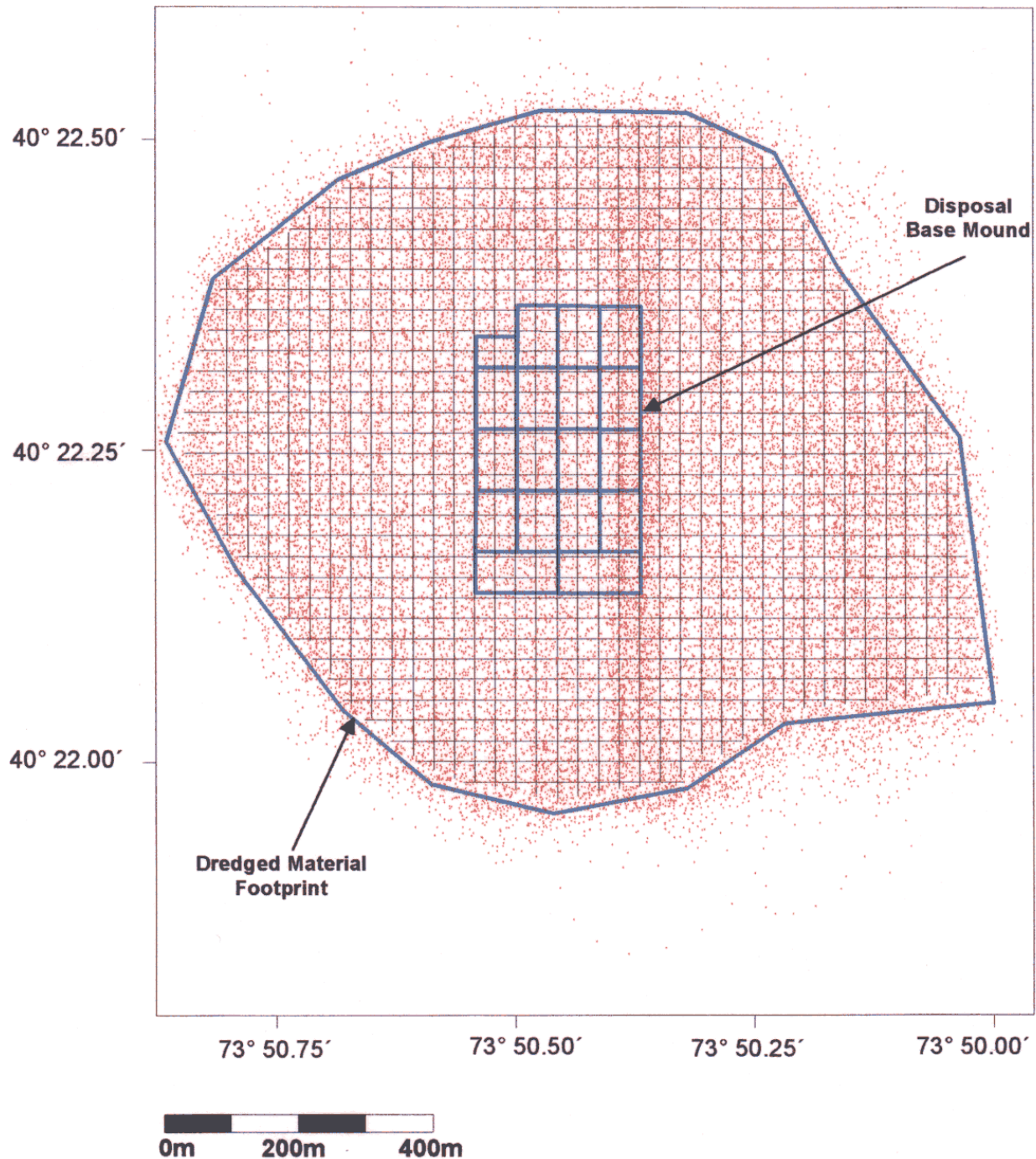


Figure 5. Track locations of the sand hopper dredges during sand cap disposal events. Taken from NYDISS data.

by applying corrections to the GPS signals that were acquired from the US Coast Guard broadcast station located at Sandy Hook, NJ.

During field operations, the PINSS provided the navigator and vessel operator with range and bearing to selected targets (i.e., beginning and end of survey lines), signal quality, time of day, and selected data from environmental sensors such as the depth sounder. A Hewlett-Packard 7475A plotter recorded the vessel track during survey operations, allowing the navigator to assess the vessel's location relative to predetermined survey lines.

Depth soundings were collected with an Odom DF3200 Echotrac® survey echosounder using a 208 kHz transducer with a 3° beam angle. The Odom simultaneously displayed water depth data on a chart recorder and transferred digital sounding data to the PINSS. The echosounder collected 6-8 soundings per second and transmitted an average value to the PINSS at a rate of one sounding per second.

A Seabird Electronics, Inc., Model SBE-19-01 conductivity-temperature-depth (CTD) profiler was used to acquire vertical profiles of sound velocity in the water column at the beginning and end of the survey day.

Water level data from the Sandy Hook, NJ, tide station were obtained from the NOAA Ocean and Lakes Levels Division (OLLD) web-server via the world wide web (WWW). The NOAA station provides water level readings at 6-minute intervals referenced to Mean Lower Low Water (MLLW). Following the survey, the water level data from Sandy Hook were applied to the bathymetric data from the survey region to remove water level variations due to tides. Note, however, that because the tide at Sandy Hook is 45 minutes later than the tide at the Mud Dump Site (NYD – Survey Branch), a time adjustment was applied during the data processing.

Depth soundings were collected along 52 north-south oriented survey lines spaced 25 m apart within the 1500 m by 1300 m survey area. This survey plan is identical to the interim-cap surveys performed by SAIC. To reduce any horizontal positioning artifacts when comparing postcap data to postdisposal data, the survey lanes were designed to coincide with lanes surveyed during the April 1997 baseline bathymetric survey.

Using SAIC's Hydrographic Data Analysis System (HDAS), bathymetric soundings were edited for outliers and corrected for sound velocity, transducer draft, and tidal variation. Following the application of all correctors, the depth soundings were spatially averaged to produce a bathymetric grid of cells each having dimensions of 25 m by 25 m. The gridded bathymetric data were used to produce the various topographic maps included in this report, and will be incorporated into the GIS database of the Disposal Analysis Network for the New York District (DAN-NY) which resides at the New York District (SAIC 1997b). Additionally, the bathymetric grid from this survey was compared with: 1) the August 19, 1997, postdisposal bathymetric survey grid, to identify the total amount of cap material that had been deposited from the beginning of capping operations, and 2) the February 1, 1998, postcap bathymetric survey, conducted for the PA, to identify any short-term changes in the cap topography related to winter storm events.

RESULTS OF BATHYMETRIC SURVEY

The bathymetric survey results are presented in a variety of graphic data products to illustrate the topography of the study area. All graphic data products have been plotted in NAD83 latitude/longitude coordinates, and depth values are relative to Mean Lower Low Water (MLLW). The 1997 capping project area is located south of the large mounds in the central Mud Dump Site (MDS), on the northeast flank of the Experimental Mud Dump (EMD) mound. Figure 4 presents a two-dimensional color bathymetric plot of the postdisposal topography used for the monitoring of capping operations within the study area from data collected in August 1997. Water depths are indicated with a contour interval of 2 feet, relative to MLLW. The 65-ft depth contour has also been included to highlight the minimum depth design criteria for the mound. For reference, the 1997 base mound region and the disposal material footprint are identified.

Figure 6 is a two-dimensional color plot of bathymetric contours within the survey area generated from the results of the April 8, 1998, postcap survey. The topography of the project area ranged from 65.0 feet at the peak of the project mound near the southwest corner of the disposal cells, to greater than 90 feet at the southeast corner of the survey area. In addition to the general reduction in depths due to cap placement, another noticeable bathymetric change between the August 1997 postdisposal survey (Figure 4) and the April 1998 postcap survey (Figure 6), was the apparent 300-ft southward migration of the topographic high located along the western boundary of the 1997 disposal area.

Three-dimensional contour plots are helpful for graphically portraying the topography of the survey area. For example, Figure 7 presents a three-dimensional view of the study area, facing northwestward. A historical dredged material mound in the northwest corner of the survey area appears relatively steep, but this is misleading and a direct result of the vertical exaggeration in the figure. The depth axis in this figure has been stretched by a factor of 43:1 to exaggerate the topography of the newly formed disposal mound.

Quantitative comparison of the bathymetric results between the April 8, 1998, postcap and August 19, 1997, postdisposal surveys yield valuable information on depth differences resulting from sand cap placement. Gridded data from the surveys were compared by algebraically subtracting the postdisposal data, used as the baseline grid, from the recent postcap grid. A two-dimensional plot of the depth difference results between the August 1997 and April 1998 surveys is presented in Figure 8. This figure effectively illustrates the area where the required 1-m thick sand cap has been placed, with the green and blue filled areas representing a complete cap.

Within the base mound region, a large area of negative depth difference values (-1 m) was observed in the western portion of the base mound area. This region corresponds with the portion of the dredged material mound that has been dubbed “Creamer’s Ridge” in honor of Thomas M. Creamer temporarily assigned to the NYD for this project. Negative difference values generally indicate a loss of material, however, in this case the negative difference values were the result of a postdisposal slope adjustment and consolidation of the project mound. Results from a subbottom profile survey conducted on September 5, 1997, by SAIC confirmed

**1997 Capping Project
Postcap Bathymetry
April 8, 1998**

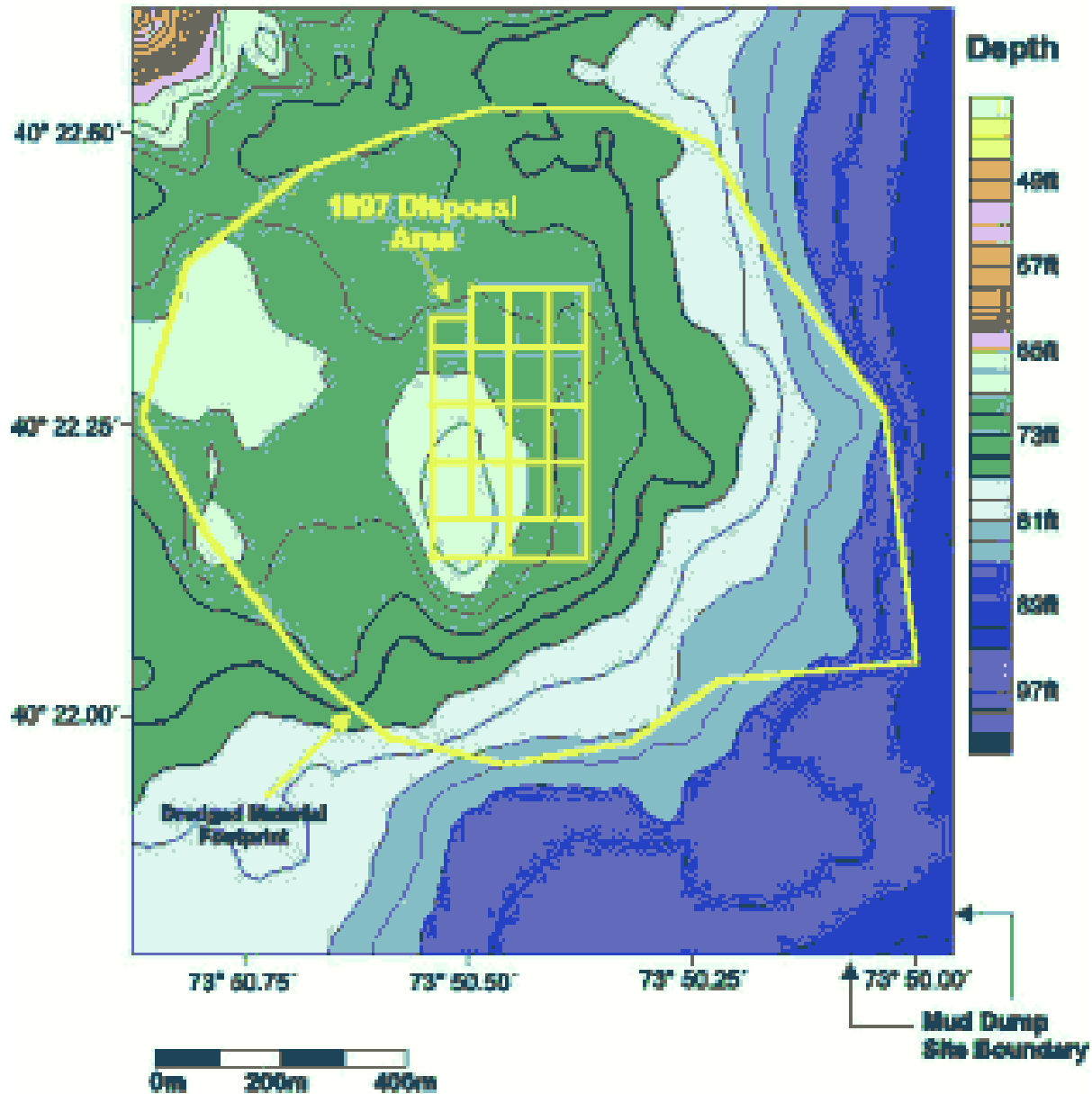


Figure 6. Color contour plot of topographic features from the post-cap bathymetry of the Category II dredged material area. The dredged material disposal cells and footprint have been plotted for reference.

**1997 Capping Project
Postcap Bathymetry
April 8, 1998**

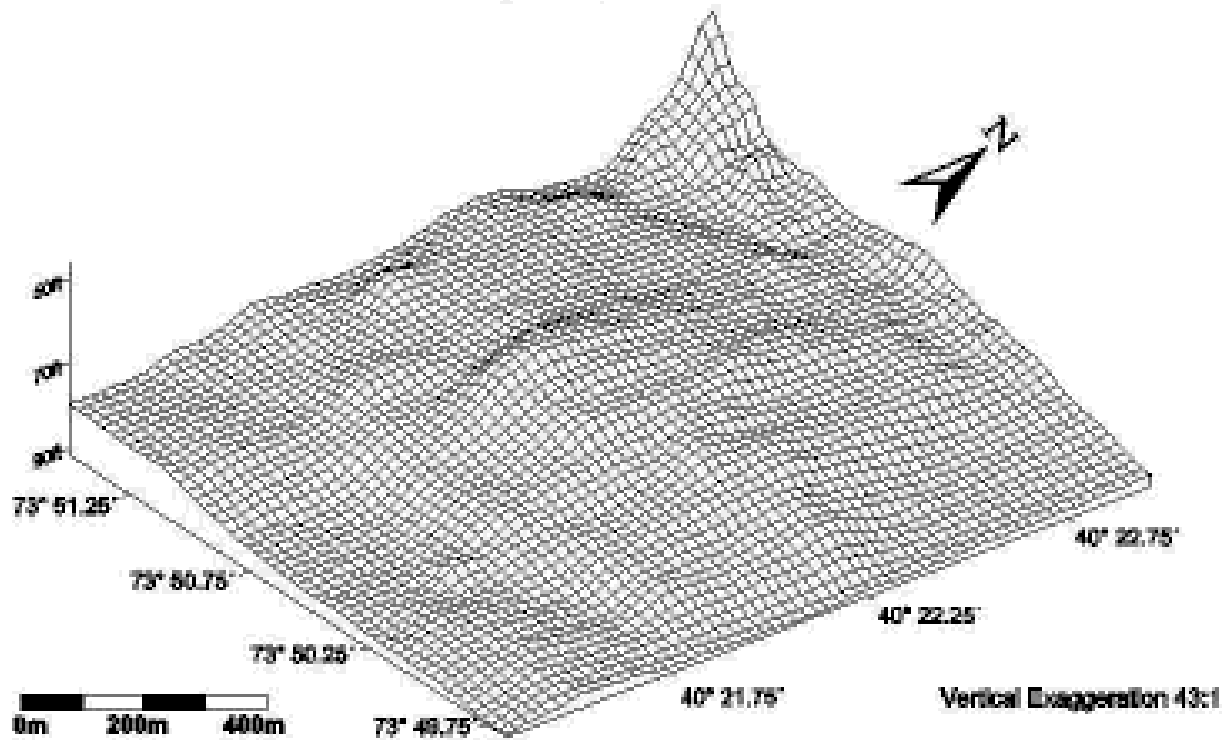


Figure 7. 3-Dimensional plot of the post cap bathymetry.

that the disposal mound underwent a slope adjustment but no material was lost from the project area (SAIC 1998b). Because sequential bathymetric depth differencing techniques could not be used to determine the sand thickness in the region of the slope adjustment, the PA conducted an interim-cap subbottom profile survey over the slope-adjusted mound and verified that a 1-m cap had been placed in the area. A subbottom survey of the entire area also was conducted by SAIC for the NYD on April 26-27, 1998, under a separate delivery order. These data are currently being processed and evaluated.

In addition to the slope adjustment on Creamer's Ridge, two small areas in the northern and eastern portions of the cap have sand thickness values less than one meter can be seen on Figure 8. Results from the December 9, 1997, bathymetric survey conducted by SAIC (Figure 2) indicates that these areas had been covered with 1 m of sand. Compaction of the underlying dredged material between the December 1997 and the February 1998 surveys resulted in the apparent cap deficiency. In order to remove the artifacts associated with compaction of underlying dredged material, a cumulative cap thickness model was constructed based on the results of a depth difference analysis between the December 9, 1997, and February 1, 1998, surveys. Positive depth differences, representing sand cap placement between December and February, were added to the cap thickness model created from the December 9, 1997, data. Figure 9 is a two-dimensional color plot of the cumulative sand cap thickness. Having removed the effects of compaction, it becomes clear that the only area of the cap that appears to have a cap less than 1-m thick is the area associated with the slope adjustment on Creamer's Ridge and a small mound in the southeast corner of the placement area. Compaction of the approximately 10-ft tall dredged material mound is the likely cause of the apparent reduced cap thickness.

A statistical analysis of the 3,233 cells that compose the depth difference grid used to generate the contour plot in Figure 9 was conducted. A total of 1,487 cells lie within the dredged material footprint. Figure 10 is a frequency distribution plot of cap thickness for each cell within the footprint area. The red bars indicate cells with thickness values less than 1-m and green indicates cells with values of one or more meters. The blue line represents the cumulative percentage of cell thickness values. The bathymetric results show that as of April 1998, 89% of the cells within the footprint had the requisite 1-m cap and that the average cap thickness is 1.25 m. Note, however, that these statistics include the cells from the slope on Creamer's Ridge and therefore, overestimate the number of cells that have not been completely capped.

To ensure there had been no topographic changes on the sand cap between the February 1, 1998, bathymetric survey and April 8, 1998, bathymetric survey, the gridded data from each survey were directly compared. Figure 11 is a two-dimensional representation of the depth difference analysis result. Although small depth differences between the two surveys were observed, they were at or near the 0.5-ft detection limit of bathymetric differencing techniques and may in part be related to horizontal sampling artifacts.

Approximately 2,000,000 yd³ of sand were dredged from Ambrose Channel (estimates from hopper dredge loads) and dispersed at the 1997 Category II Project Area. The volume of sand placed on the seafloor of the project also was calculated from the depth difference analysis between the August 1997 postdisposal and April 1998 postcap surveys. Bathymetric depth

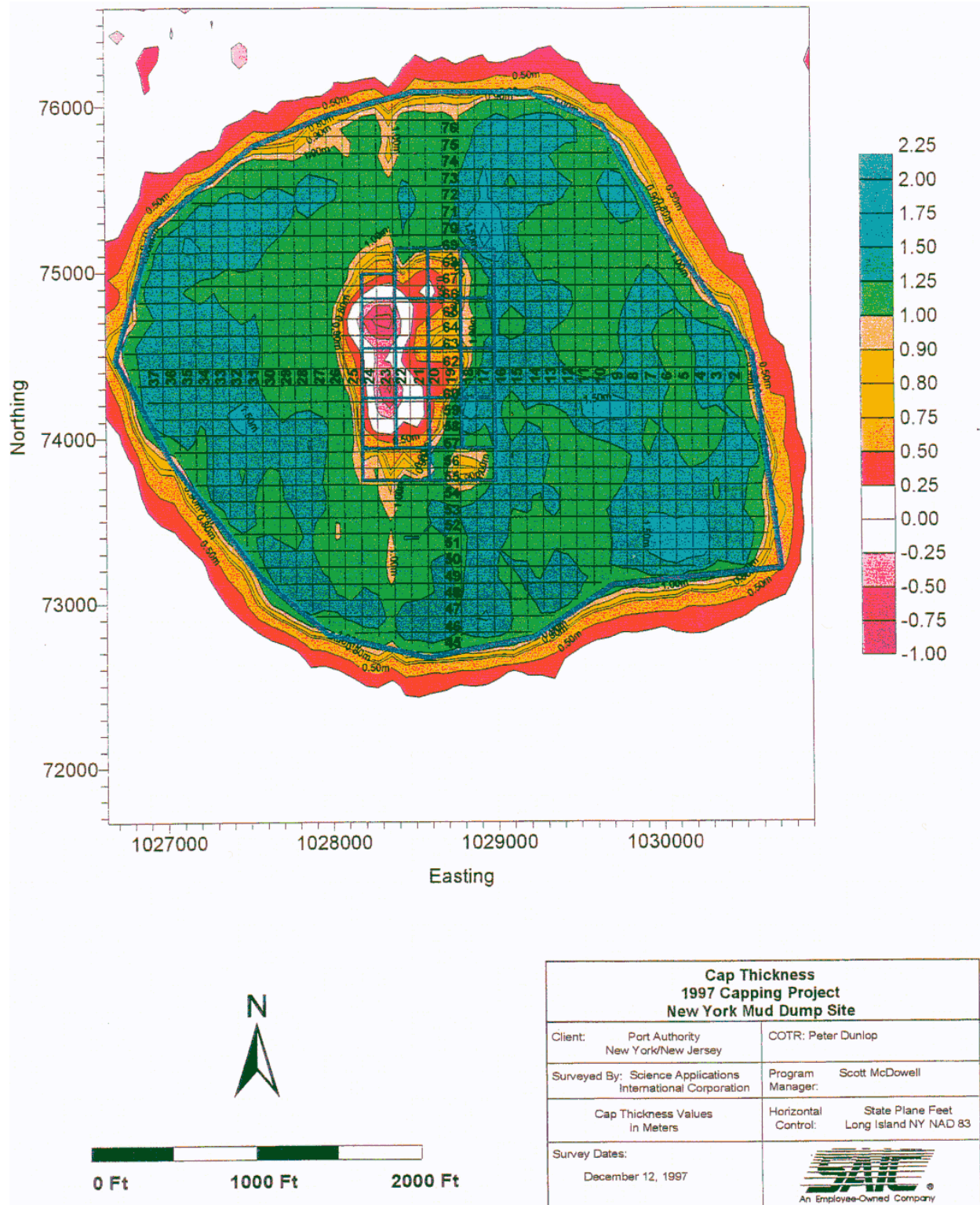


Figure 8. Color plot of depth difference results between 5th interim-cap bathy and post-cap bathy.

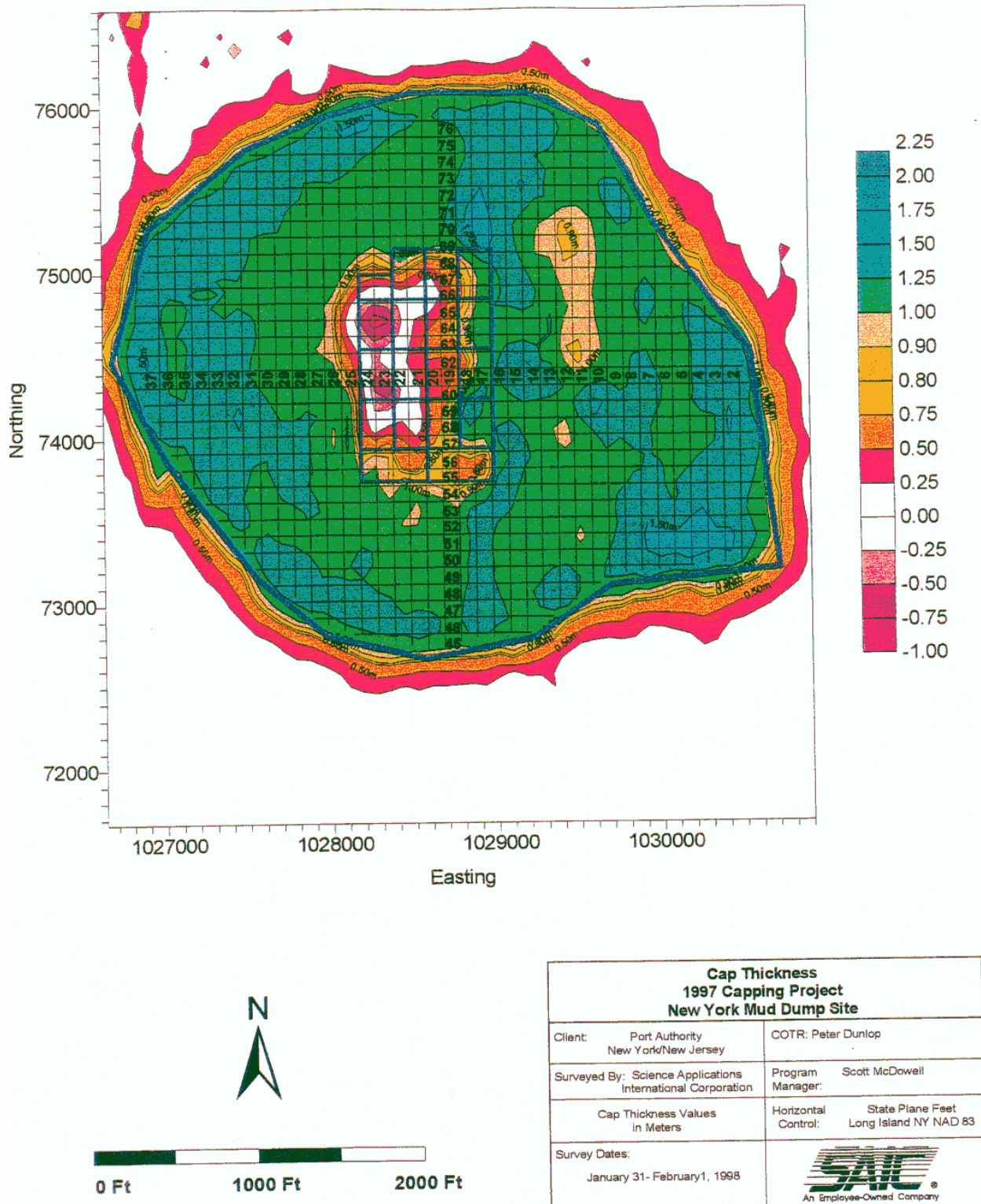


Figure 9. Color plot of cumulative cap thickness using based on results of comparison of the December 9, 1997, and February 1, 1998 cap surveys.

Cap Thickness Frequency Distribution April 8, 1998

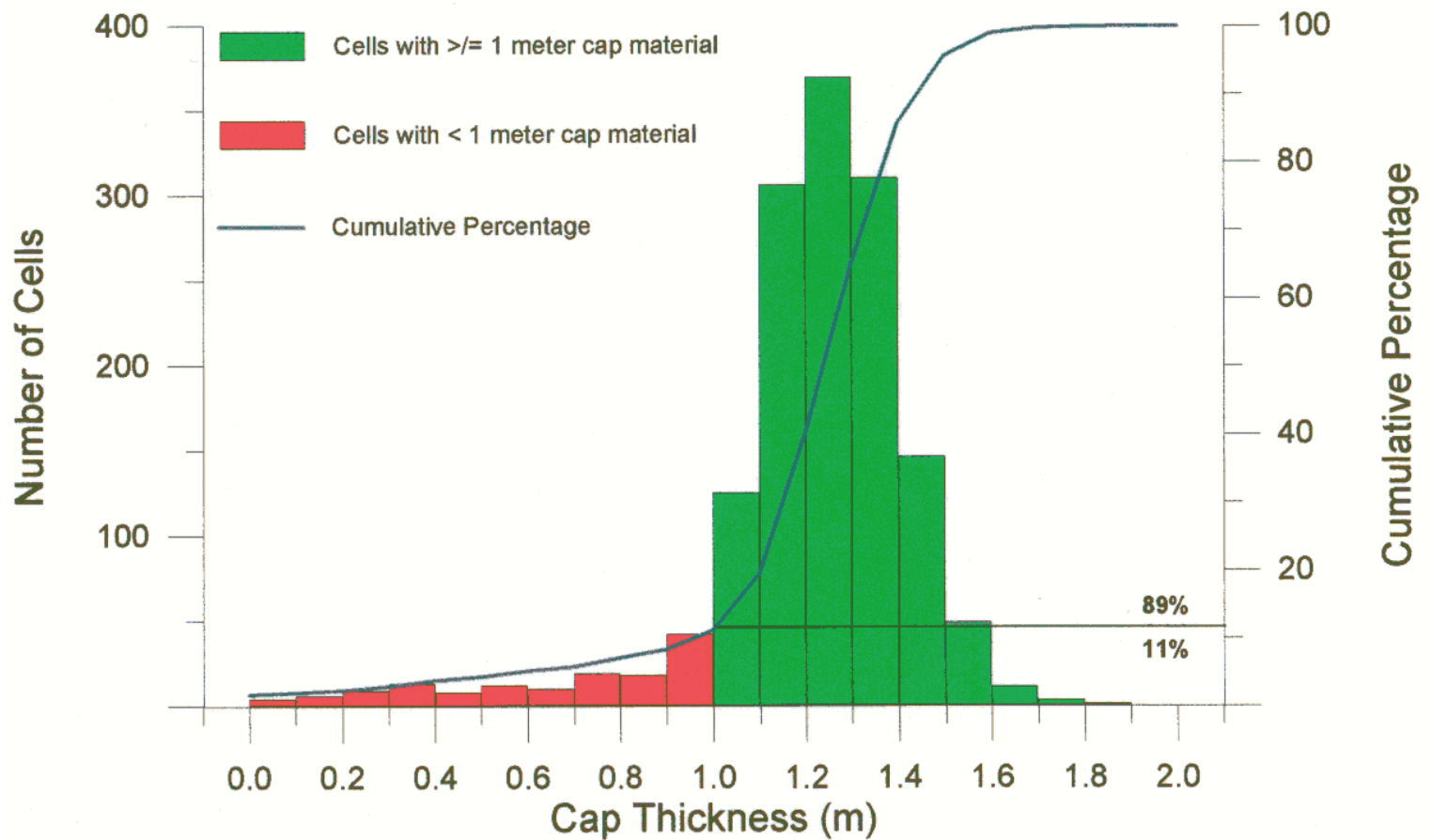


Figure 10. Frequency distribution of cap thickness values from the postcap depth difference grid. This distribution is based on a total of 1,487 25 m cells within the dredged material footprint.

**1997 Capping Project
Depth Difference Results
February 1, 1998 - April 8, 1998**

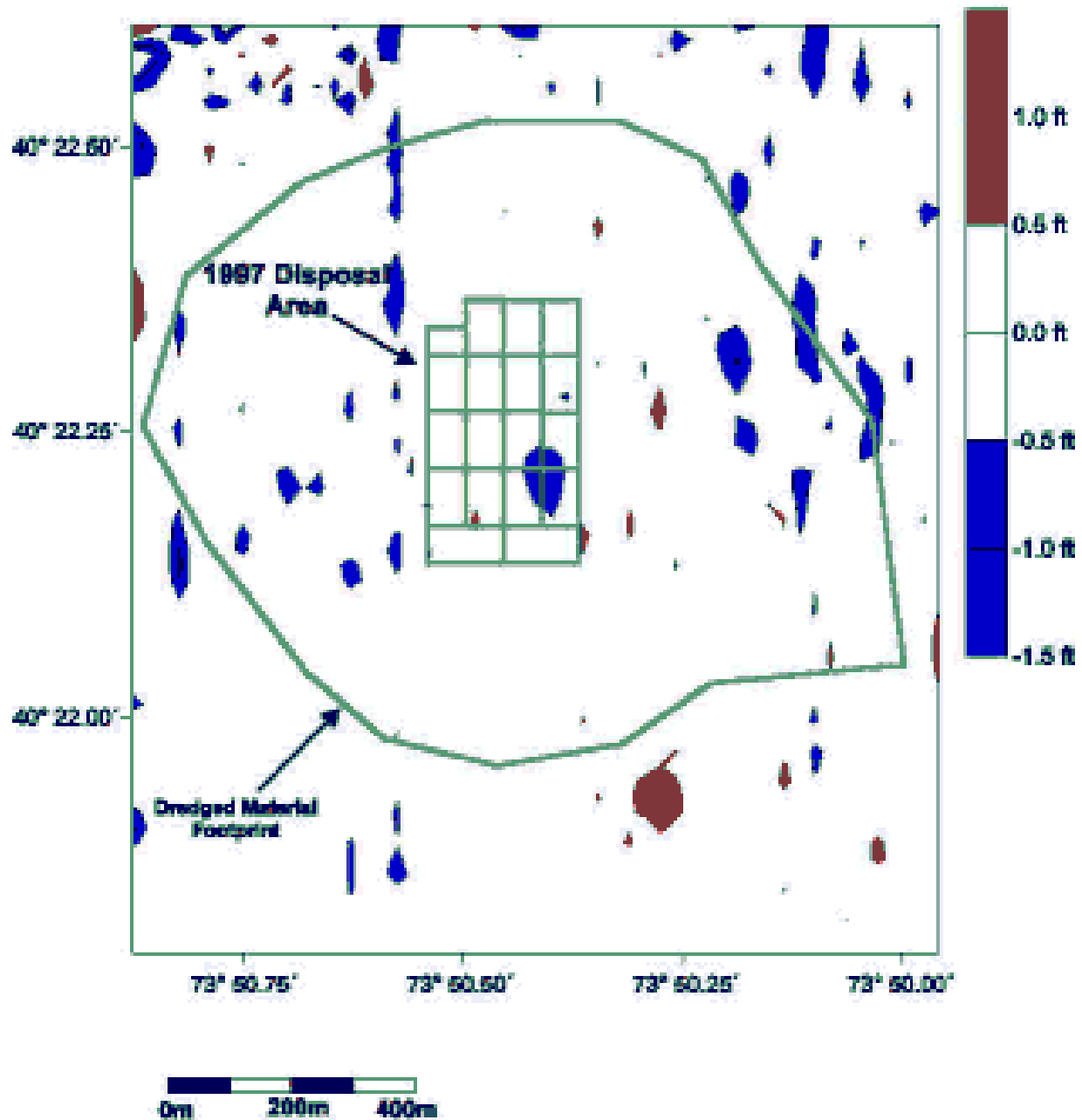


Figure 11. 2-dimensional color plot of depth difference values between the February 1, 1998, and April 8, 1998, postcapping bathymetric surveys.

differencing techniques could only account for 1,700,000 yd³ of sand. The calculated bathymetric volume represents an underestimation of the true, in situ volume because of the postdisposal slope adjustment and consolidation.

RESULTS OF EAST-WEST SURVEY TRANSECTS

In addition to the 52 north-south bathymetric survey lines, seven of the 17 east-west crosslines occupied during baseline studies were resurveyed during the postcap survey. These lines were centered on the 1997 base mound area and spaced 50 m apart (Figure 12). Soundings from these crosslines were edited and corrected in the same manner as for data from the north-south lines. Figures 13-19 illustrate depth profiles from the crosslines labeled 6 through 12, with water depth plotted on the vertical axis and Easting coordinates (NAD 83 State Plane, zone 3104 - Long Island) plotted on the horizontal axis, both in units of feet. In the individual profile plots, the April 23, 1997, baseline bathymetric data were superimposed on the postdisposal profile data (August 19, 1997), and the postcap (April 8, 1998) data to clearly show the location and elevation of the dredged material accumulation and the overlying sand cap material. Note, however, that a vertical exaggeration of 103:1 has been applied to the depth profiles to enhance the topographic representation.

Close inspection of the profile plots reveals that in each of the seven crossline profiles, the postdisposal data may not be covered by the cap along the eastern boundary of the base mound area. In actuality, the dredged material is covered with the required amount of sand cap material; the deception comes from the downward slope movement of the dredged material that took place previously.

**1997 Capping Project
April 8, 1998
East-West Crosslines**

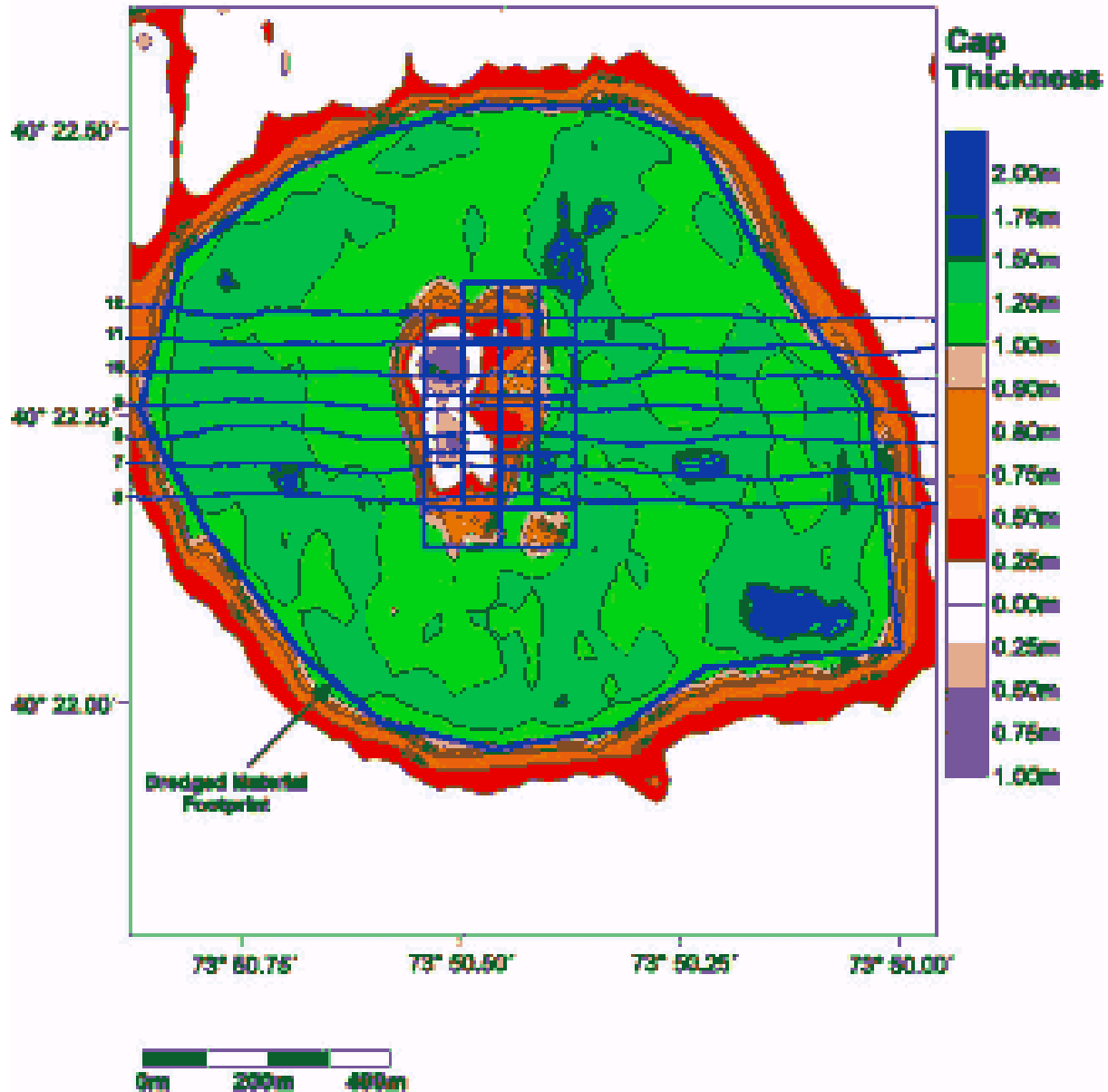


Figure 12. Track plot of seven east-west bathymetric crosslines surveyed across the 1997 Category II Project sand cap.

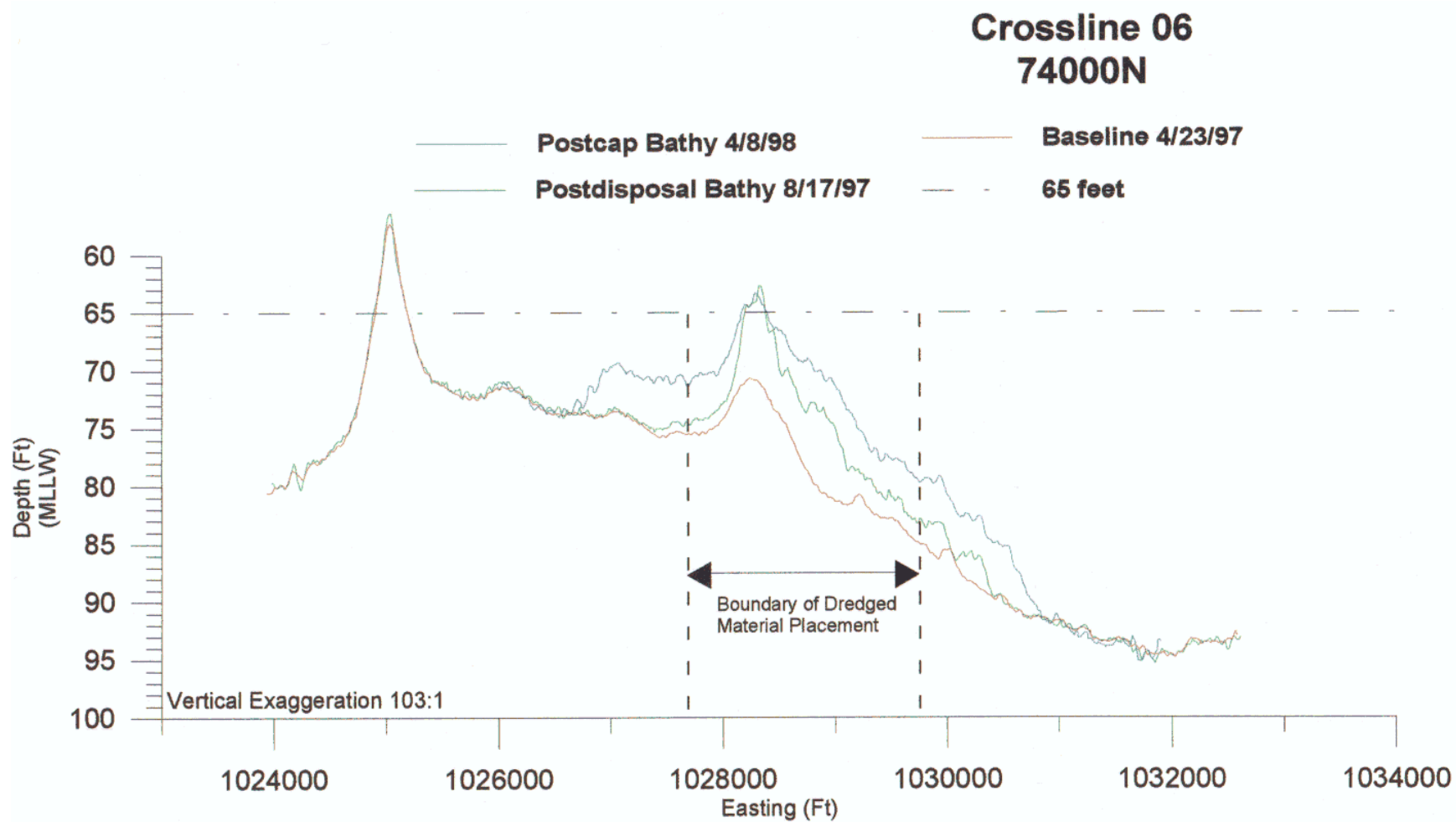


Figure 13. Time series bathymetric profile data from crossline 6. Profile data from the baseline, postdisposal and postcap surveys are presented.

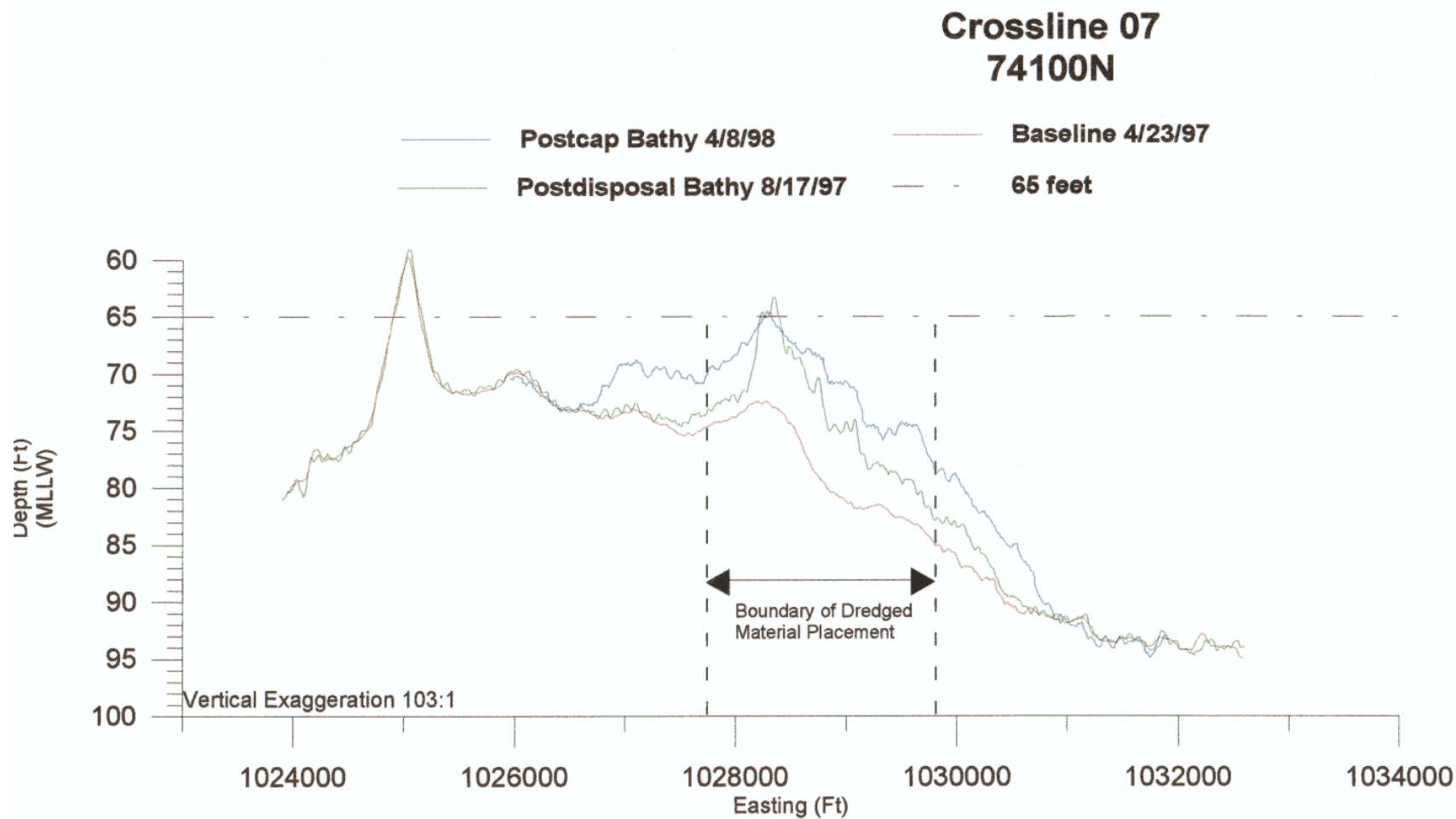


Figure 14. Time series bathymetric profile data from crossline 7. Profile data from the baseline, postdisposal and postcap surveys are presented.

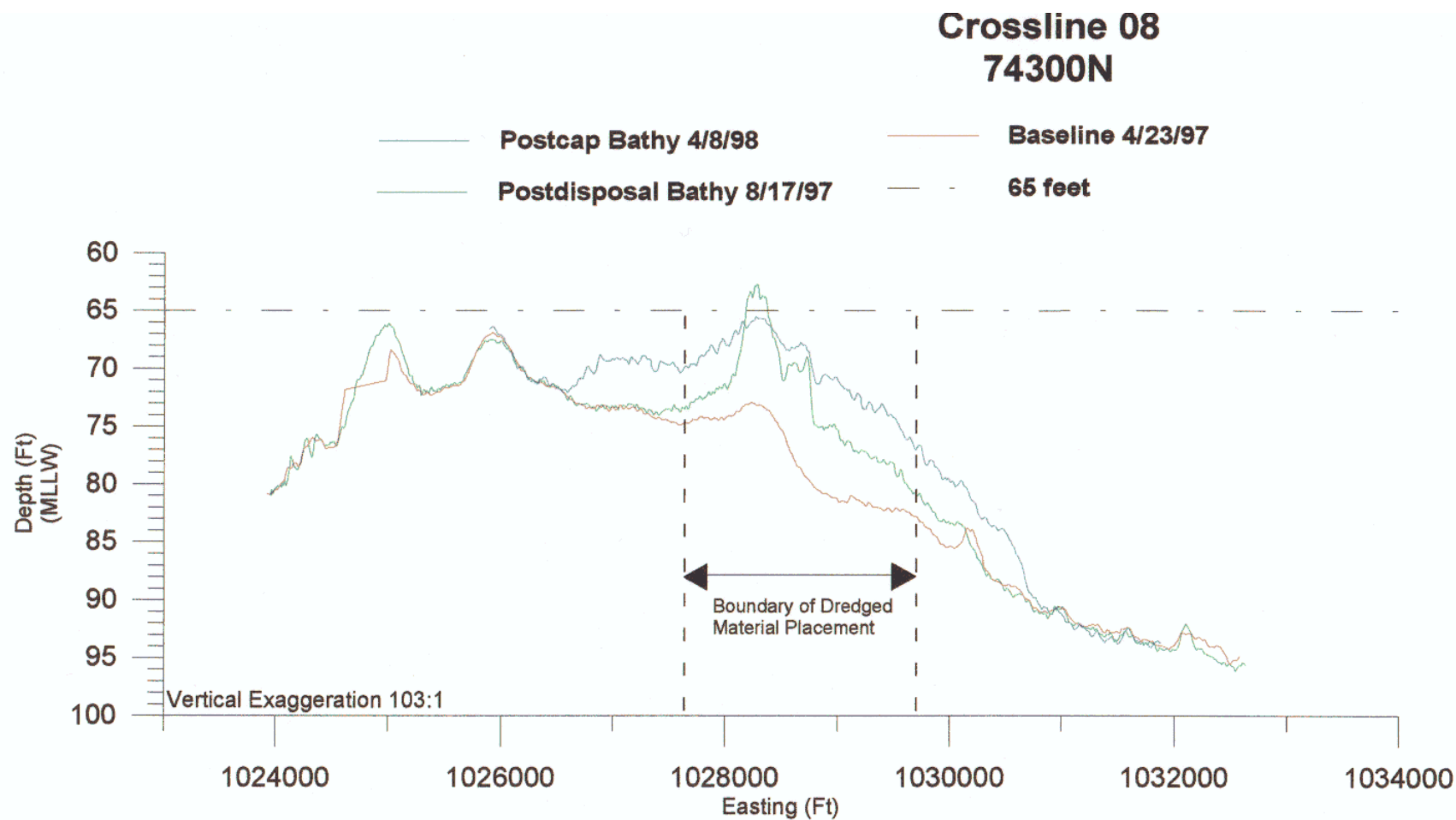


Figure 15. Time series bathymetric profile data from crossline 8. Profile data from the baseline, postdisposal and postcap surveys are presented.

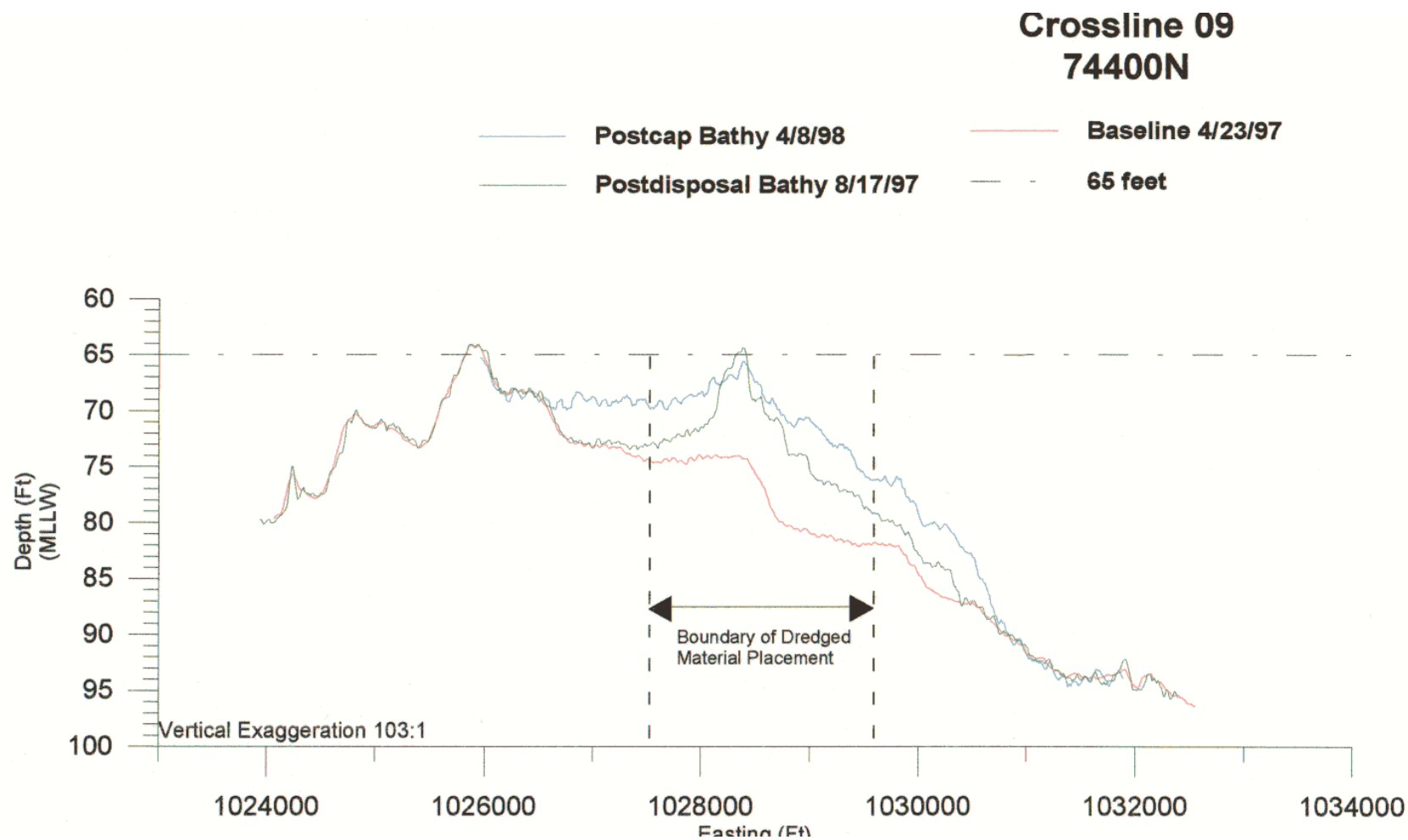


Figure 16. Time series bathymetric profile data from crossline 9. Profile data from the baseline, postdisposal and postcap surveys are presented.

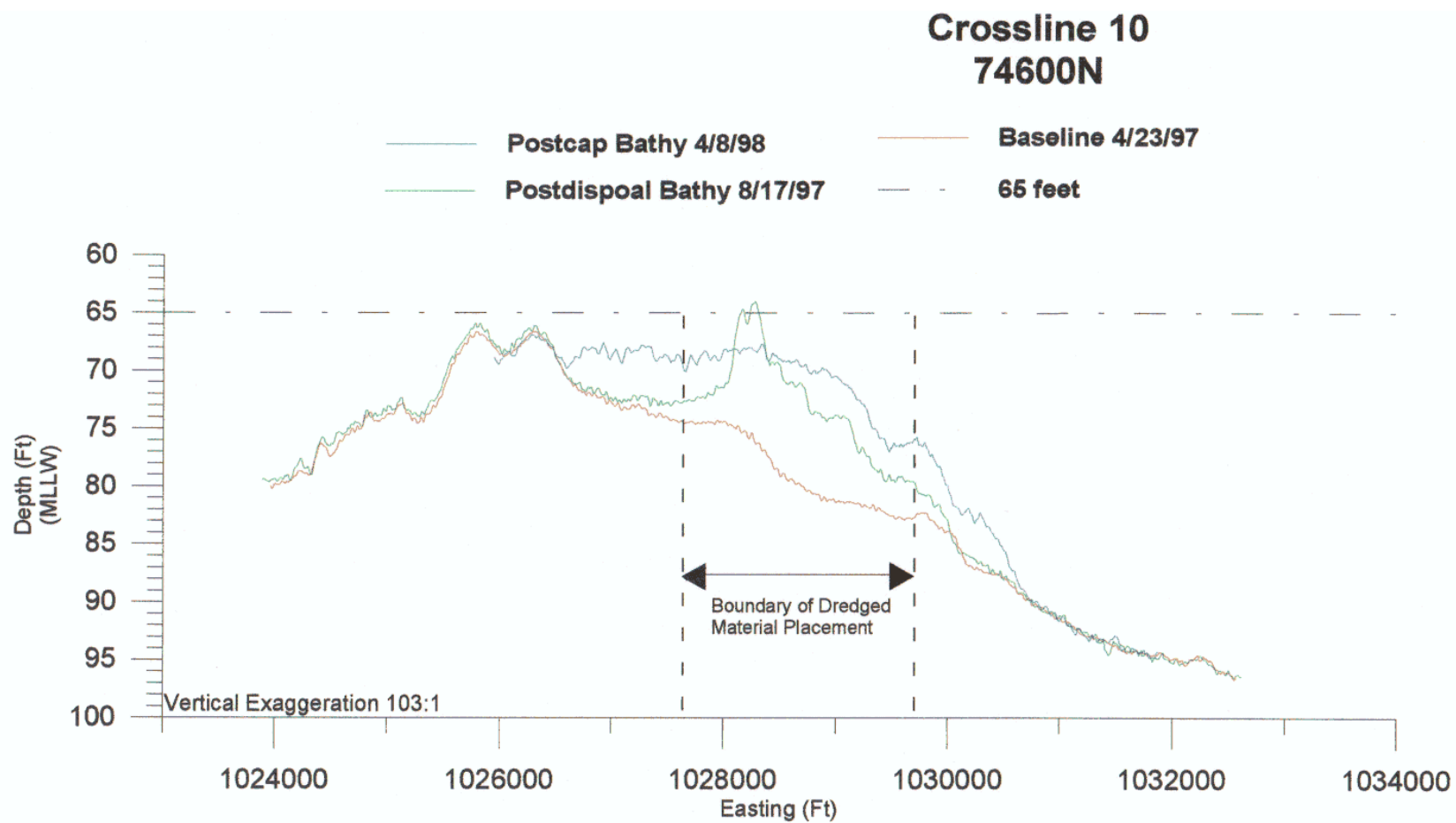


Figure 17. Time series bathymetric profile data from crossline 10. Profile data from the baseline, postdisposal and postcap surveys are presented.

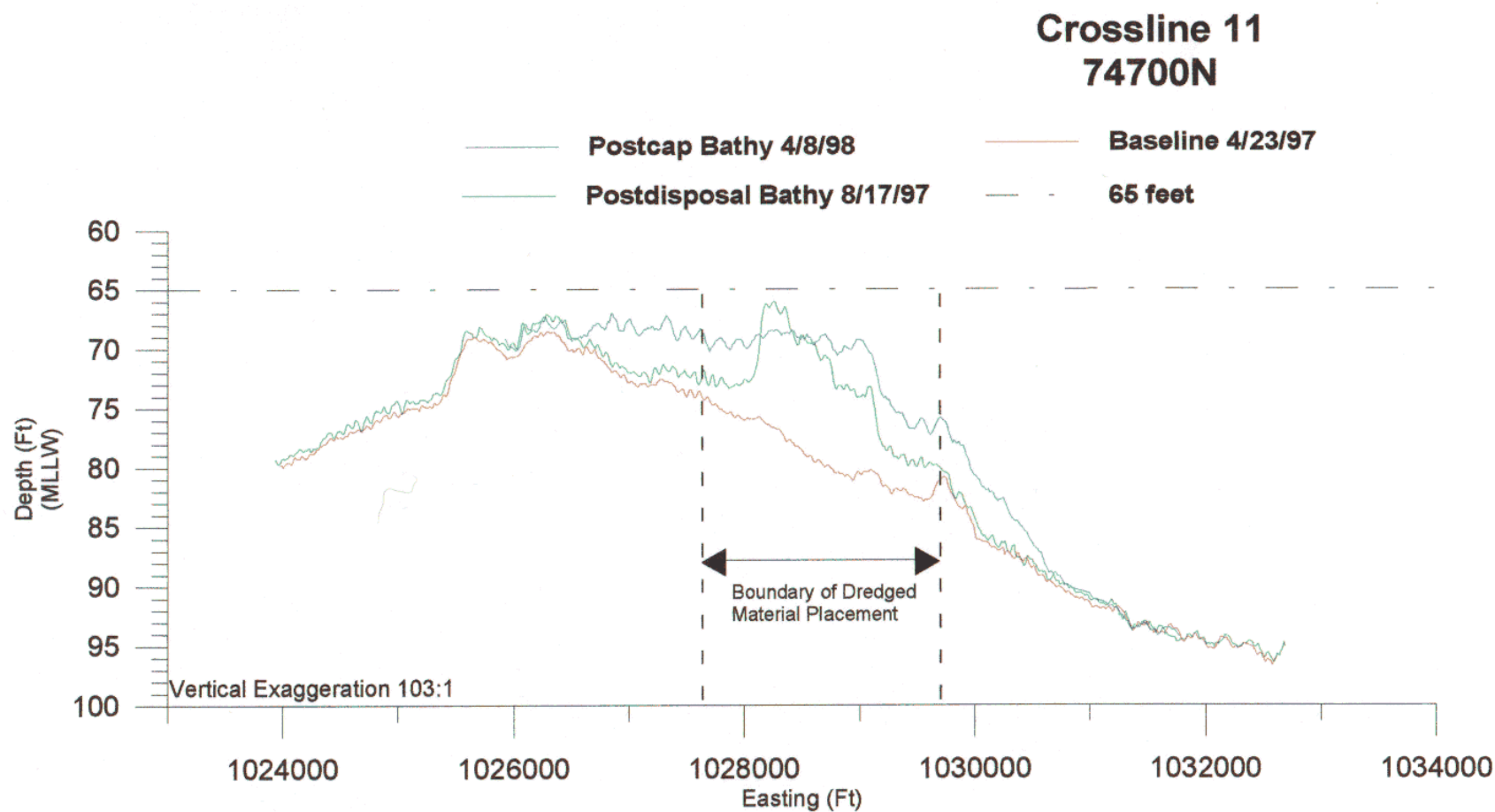


Figure 18. Time series bathymetric profile data from crossline 11. Profile data from the baseline, postdisposal and postcap surveys are presented.

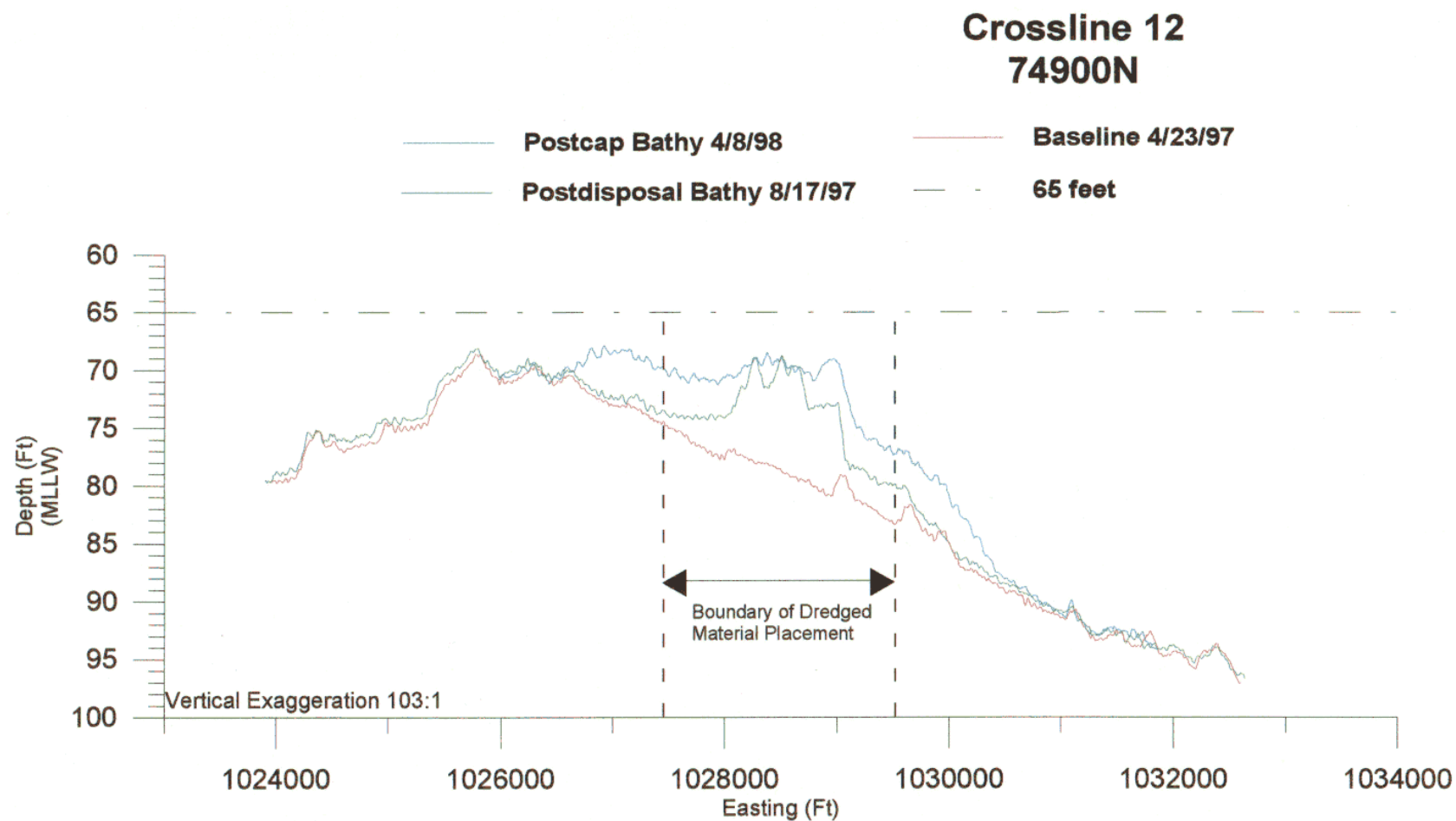


Figure 19. Time series bathymetric profile data from crossline 12. Profile data from the baseline, postdisposal and postcap surveys are presented.

REFERENCES

- SAIC. (1997a). Automated Surveillance of Capping Operations during the 1997 Category II Project at the New York Mud Dump Site. Report #73 of the New York Mud Dump Site Studies. USACE Contract No. DACW51-97-D-0014. SAIC Report No. 422.
- SAIC. (1997b). Selection and Population of the Initial Database for DAN-NY. Report #70 of the New York Mud Dump Site Studies. USACE Contract No. DACA65-95-D-0063. SAIC Report No. 419.
- SAIC. (1998a). Summary of Cap Monitoring Survey Results for the 1997 Category II Capping Project. Report #80 of the New York Mud Dump Site Studies. SAIC Report No. 432.
- SAIC. (1998b). The 1997 Category II Project at the New York Mud Dump Site: Results from the September 1997 Postdisposal Subbottom Profile Survey. Report #75 of the New York Mud Dump Site Studies. USACE Contract No. DACW51-97-D-0014. SAIC Report No. 424.